MOLDING PROCESS FOR MANUFACTURING A MOLDED ARTICLE

This application is a continuation-in-part (CIP) of a co-pending U.S. Patent Application No. 09/680,295, filed by the applicant on October 6, 2000, the entire disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the invention

This invention relates to a molding process for manufacturing a molded article, more particularly to a molding process for manufacturing a molded article formed with an channel.

2. Description of the related art

Molded articles for decoration, souvenir, stationery and the like are normally provided with channels for various purposes. Fig. 1 illustrates a letter opener 1 including a blade 11 and a handle 2 with a channel 10 for insertion of the blade 11. Figs. 2 to 4 illustrate how a channel 132 is formed in a molded decoration 14 made of a metal. The decoration 14 is prepared by molding the metal in a mold 12 which includes upper and lower mold halves 120, 121 confining a mold cavity therebetween. Two pairs of opposite positioning grooves 122 are respectively formed in confronting surfaces of the upper and lower mold halves 120, 121 at two opposite sides of the mold cavity, and are communicated with the mold cavity.

To form the channel 132 in the decoration 14, a rigid hollow rod 13 is placed in the mold cavity with two opposite ends of the rod 13 being placed and positioned in the grooves 122. Metal in a molten state is then introduced into the mold cavity and is molded over the rod 13 to form a molded part. The two opposite ends of the rod 13 that protrude outwardly from the thus formed molded part are subsequently cut off (see Fig. 3) or the rod 13 is completely withdrawn from the thus formed molded part to form the channel 132 in the decoration 14 (see Fig. 4). When the rod 13 is to be withdrawn from the molded part in the process of forming the channel 132, the rod 13 can be solid instead of being hollow.

The manufacture of the decoration 14 is disadvantageous in that since a portion of the rod 13 remains in the decoration 14 and since the protruding portions of the rod 13 are cut off and will become waste products, the manufacturing cost will be increased and disposal of the waste products will be troublesome. Moreover, since the rod 13 is tightly surrounded by the molded part, it is difficult to withdraw the same from the molded part. There is thus a tendency for the molded part and/or the rod 13 to be damaged during the withdrawing action.

The mold 12 described above can only produce a channel having a simple shape, and requires the

grooves 122 to be formed in the confronting surfaces of the upper and lower mold halves 120, 121. When a channel (indicated as reference number 133' in Fig. 6) having a complex shape, such as a curved shape or a bent shape, is to be formed in a molded part 14", or when a plurality of channels 132, 132', 133, 133' extending in different directions are to be formed in molded parts 14', 14" (see Figs. 5 and 6), a multi-piece mold (i.e. more than two pieces) is required for manufacturing the molded part. As such, the manufacture of the molded part becomes very complex and costly. While the channels 132, 133 in the molded part 14' can be formed by drilling, the drilling process is time consuming and can result in an enormous increase in production cost. Furthermore, it is impossible to form the curves channel 133' of the molded part 14" by drilling. On the other hand, the channels 132, 132', 133, 133" in the molded parts 14', 14" are formed by separating the molded parts into different pieces. At least two mold pieces have to be combined with each other by welding or gluing to form each of channels 132, 132' 133, 133'. However, the welding process or the gluing process is also time consuming, and there is a tendency for the molded parts 14', 14" to break at locations where the welding or the gluing is applied. Moreover, when two channels in two pieces are

connected to form a single channel in the assembled piece, and when the single channel is to be used for storing liquid, there is a tendency for the liquid to leak at locations where the welding or the gluing is applied.

SUMMARY OF THE INVENTION

Therefore, the object of the present invention is to provide a molding process for manufacturing a molded article that is capable of overcoming the aforementioned drawbacks of the prior art.

According to the present invention, a molding process for manufacturing a molded article comprises the steps of: (a) preparing a mold having a mold cavity that has a shape conforming to that of the molded article; (b) preparing a flexible hollow member and a supporting member, the hollow member having an open end and defining an inner passage that extends from the open end; (c) inserting the supporting member into the flexible hollow member in a manner that the supporting member extends through the open end and into the inner passage in a direction along the inner passage so as to prevent the hollow member from collapsing during a subsequent molding step; (d) placing assembly of the hollow member and the supporting member in the mold cavity; (e) closing the mold and introducing a molding raw material into the mold cavity around the hollow member to form a molded

part around the hollow member in a manner that the open end of the hollow member is exposed from the molded part; (f) removing the molded part together with the hollow member and the supporting member from the mold cavity; and (g) withdrawing the supporting member and the hollow member from the molded part to form a channel in the molded part.

BRIEF DESCRIPTION OF THE DRAWING

In the following drawings which illustrate an embodiment of the invention,

Fig. 1 is an exploded perspective view of a letter opener including a handle provided with a channel;

Fig. 2 illustrates how a decoration with a channel is prepared in a mold by a conventional molding process;

Figs. 3 and 4 illustrate different ways of forming the channel in the decoration;

Figs. 5 and 6 respectively illustrate decorations provided with different channel configurations;

Fig. 7 illustrates a mold and a molded article molded in the mold according to a molding process embodying this invention;

Fig. 8 illustrates how a bent channel is formed in the molded article of Fig. 7;

Fig. 9 illustrates a modified flexible tube for

forming the bent channel in the molded article of Fig. 7;

Fig. 10 illustrates another molded article provided with two channels in two different directions and prepared according to the molding process of this invention;

Figs. 11 and 12 illustrate another molded article provided with a channel and a patterned inner face and prepared in an open mold according to the molding process of this invention;

Fig. 13 illustrates another molded article similar to that of Fig. 12 but prepared in a closed mold according to the molding process of this invention;

Figs. 14 and 15 illustrate another molded article provided with a channel and a patterned inner face and prepared in an open mold according to the molding process of this invention; and

Figs. 16 and 17 illustrate another molded article provided with a channel and a patterned inner face and prepared in a closed mold according to the molding process of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

For the sake of brevity, same reference numerals are used to denote similar elements throughout the specification.

Figs. 8, 12, 15, and 17 illustrate different

configurations of molded articles 6 prepared according to a molding process embodying this invention. Each of the molded articles 6 is formed with a channel 61 therein.

Referring to Fig. 7, the molding process includes the steps of: (a) preparing a mold 2 having a mold cavity 23 that has a shape conforming to that of the molded article 6; (b) preparing a flexible hollow member 3 and a supporting member 4, the hollow member 3 having an open end 32 and defining an inner passage 33 that extends from the open end 32; (c) inserting the supporting member 4 into the flexible hollow member 3 in a manner that the supporting member 4 extends through the open end 32 and into the inner passage 33 in a direction along the inner passage 33 so as to prevent the hollow member 3 from collapsing during a subsequent molding step; (d) placing assembly of the hollow member 3 and the supporting member 4 in the mold cavity 23; (e) closing the mold 2 and introducing a molding raw material into the mold cavity 23 around the hollow member 3 to form a molded part around the hollow member 3 in a manner that the open end 32 of the hollow member 3 is exposed from the molded part; (f) removing the molded part together with the hollow member 3 and the supporting member 4 from the mold cavity 23; and (g) withdrawing the supporting member 4 and the hollow member 3 from the

molded part to form the channel 61 in the molded part.

Referring to Figs 7 and 8, the mold 2 includes upper and lower mold halves 21, 22 that confine the mold cavity 23. A pair of upper positioning grooves 210, 211 are formed in a bottom face of the upper mold half 21. A pair of lower positioning grooves 220, 221 are formed in a top face of the lower mold half 22, and respectively complement with the upper positioning grooves 210, 211. A runner has complementary runner halves 223 that are formed respectively in the upper and lower mold halves 21, 22. The upper and lower positioning grooves 210, 211, 220, 221 are disposed externally of and in communication with the mold cavity 23. The hollow member 3 is in the form of a flexible tube 3 that has a bent portion 31 which confines a curved section 330 of the inner passage 33. The supporting member 4 is in the form of a flexible supporting wire that is inserted into the tube 3, that extends through and along the entire length of the tube 3 for supporting the tube 3, and that has a pulling end 41 exposed from the tube 3 for facilitating withdrawal of the wire 4 from the tube 3. The tube 3 has two opposite ends (one of which defines the open end 32) that are positioned in the upper and lower positioning grooves 210, 211, 220, 221 for facilitating withdrawal of the tube 3 from the molded part. The molding raw material

is introduced through the runner and into the mold cavity 23. The molded part encloses the assembly of the tube 3 and the supporting member 4 in a manner such that the two opposite ends of the tube 3 are exposed from the molded part.

Since the supporting member 4 is flexible, it is relatively easy to withdraw the same from the tube 3. In addition, since the tube 3 is also flexible, it becomes even easier to withdraw the tube 3 from the molded part once the supporting member 4 has been removed, thereby eliminating the aforesaid drawbacks as encountered in the prior art.

The molding process of this invention is preferably adopted for manufacturing a molded article made of metal, such as a Pb-Sn alloy (Pewter). As such, the flexible tube 3 employed in the molding process is preferably made of silicone rubber having a melting point higher than that of the material of the molded article, and the supporting member 4 is made of a metal having a melting point higher than that of the material of the molded article. Since the structure and the property of the tube 3 remain unchanged after the molding process, it can be reused for subsequent molding of another article.

As illustrated in Fig. 9, one of the two opposite ends of the flexible tube 3 can have a threaded outer face 30 so as to form the channel 61 with an inner

threaded end.

As illustrated in Fig. 10, since both the tube 3 and the supporting member 4 are flexible, it is relatively easy to remove a molded article 6, which has channels 61, 61' extending in different planes in the molded article 6, from a two-piece mold 2. In the example of Fig. 10, one channel 61' is formed in the lower mold half 22 and is inclined relative to a horizontal plane defined by the mating faces of the upper and lower mold halves 21, 22 where the other channel 61 is formed.

Referring to Figs. 11 to 13, the hollow member 3 employed in the molding process is configured for forming a human-like pattern on an inner face 611 of the molded article 6 that defines the channel 61. The mold 2 employed in the molding process can be an open mold (see Fig. 11) or a closed mold (see Fig. 13). A flexible cap member 42 is used for isolating the pulling end 41 of the supporting member 4 and the open end 32 of the hollow member 3 from the molding raw material when introducing the molding raw material into the mold cavity 23. The cap member 42 has a peripheral wall defining a recess which has an enlarged portion 421 and a reduced portion 422 reduced from the enlarged portion 421. The cap member 42 is placed in the mold cavity 23 in a manner that the peripheral wall fits snugly in an end portion 230 of

the mold cavity 23, that the open end 32 of the hollow member 3 is fittingly received in the enlarged portion 421 of the recess, and that the pulling end 41 of the supporting member 4 is fittingly received in the reduced portion 422 of the recess so as to permit exposure of the open end 32 of the hollow member 3 and the pulling end 41 of the supporting member 4 from the molded part, thereby facilitating withdrawal of the hollow member 3 and the supporting member 4 from the molded part. It is noted that the cap member 42 has a cross-section larger than that of the hollow member 3 so as to separate the hollow member 3 from an inner wall of the mold cavity 23.

Referring to Figs. 14 and 15, the hollow member 3 employed in the molding process can be in the form of a cylindrical tube with a patterned outer face 30' so as to form the same pattern on the inner face 611 of the molded article 6. Two cap members 42 are used for preparing the molded article 6.

Referring to Figs. 16 and 17, the hollow member 3 employed in the molding process is the same as the hollow member of Fig. 14, while the mold cavity 23 of the mold employed in the molding process is cylindrical in shape so as to form the molded article 6 with a cylindrical shape.

It is noted that each of the supporting members 4, illustrated in Figs. 11, 14, and 16, is in the form

of a rigid rod in contrast to the flexible wire shown in Fig. 7.

With the invention thus explained, it is apparent that various modifications and variations can be made without departing from the spirit of the present invention. It is therefore intended that the invention be limited only as recited in the appended claims.